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L14: Entry 2 of 2 File: USPT Aug 5, 1997

US-PAT-NO: 5654968
DOCUMENT-IDENTIFIER: US 5654968 A

TITLE: Method and apparatus for managing a number of time slots during which plural bidding devices can request communication access to a central device

DATE-ISSUED: August 5, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Smiroldo; Michael	Belmont	CA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Multipoint Networks	Belmont	CA			02

APPL-NO: 08/569689 [PALM]
DATE FILED: December 8, 1995

INT-CL-ISSUED: [06] H04 J 3/14, H04 J 3/16

US-CL-ISSUED: 370/443; 370/462, 370/468
US-CL-CURRENT: 370/443; 370/462, 370/468

FIELD-OF-CLASSIFICATION-SEARCH: 370/95.1, 370/95.2, 370/95.3, 370/79, 370/80, 370/81, 370/82, 370/83, 370/85.3, 370/85.2, 370/13, 370/17, 370/431, 370/432, 370/437, 370/442, 370/443, 370/444, 370/445
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

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	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	5303234	April 1994	Kou	370/95.3
☐	5384777	January 1995	Ahmadi et al.	370/85.2

ART-UNIT: 267

PRIMARY-EXAMINER: Chin; Wellington

ASSISTANT-EXAMINER: Vu; Huy D.

ATTY-AGENT-FIRM: Burns, Doane, Swecker & Mathis, LLP

ABSTRACT:

The present invention is directed to maximizing efficiency, or throughput, in a communications network where plural bidding devices arbitrate for access to a central device, while fairness in the bid arbitration process is maintained. Such enhanced operation is achieved by providing at least one central device, such as a hub, with an ability to receive bid indices representing bid success rates from each of a plurality of secondary devices. The plurality of secondary devices can be remote units referred to herein as launch pads. The bid indices represent the ability of each launch pad to successfully arbitrate for access to the hub. The hub collects the bid indices from all of the active launch pads and evaluates (for example, averages) them over a reasonable period of time to create a hub goal index. The hub goal index is then broadcast back to all of the launch pads so that each of the launch pads can evaluate its own bid index relative to the hub goal index, and then use this comparative information to modify its frequency of bidding for future access to the hub. As a result, launch pads tend to spread out into different bidding groups, each bidding group having a unique bid-to-data-transfer cycle time. At the same time the hub creates the hub goal index, the hub also creates a group bid index for each launch pad bidding group. The hub continually monitors a worst group bid index and uses it to modify a number of available time slots during which the launch pads can bid for access to the hub.

17 Claims, 22 Drawing figures

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L14: Entry 2 of 2 File: USPT Aug 5, 1997

DOCUMENT-IDENTIFIER: US 5654968 A
TITLE: Method and apparatus for managing a number of time slots during which plural bidding devices can request communication access to a central device

Abstract Text (1):
The present invention is directed to maximizing efficiency, or throughput, in a communications network where plural bidding devices arbitrate for access to a central device, while fairness in the bid arbitration process is maintained. Such enhanced operation is achieved by providing at least one central device, such as a hub, with an ability to receive bid indices representing bid success rates from each of a plurality of secondary devices. The plurality of secondary devices can be remote units referred to herein as launch pads. The bid indices represent the ability of each launch pad to successfully arbitrate for access to the hub. The hub collects the bid indices from all of the active launch pads and evaluates (for example, averages) them over a reasonable period of time to create a hub goal index. The hub goal index is then broadcast back to all of the launch pads so that each of the launch pads can evaluate its own bid index relative to the hub goal index, and then use this comparative information to modify its frequency of bidding for future access to the hub. As a result, launch pads tend to spread out into different bidding groups, each bidding group having a unique bid-to-data-transfer cycle time. At the same time the hub creates the hub goal index, the hub also creates a group bid index for each launch pad bidding group. The hub continually monitors a worst group bid index and uses it to modify a number of available time slots during which the launch pads can bid for access to the hub.

Drawing Description Text (11):
FIG. 8 illustrates bid behavior of two odd numbered launch pads, one having four time assignment frames per group and another having eight time assignment frames per group;

Detailed Description Text (31):
A logical unit number (LUN) field of a destination address is active in both Acknowledgement and Assignment headers. The logical unit number is used to index a launch pad database to track data packet sequence numbering and other housekeeping matters for each application program interacting with the radio access protocol.

Detailed Description Text (32):
A send sequence number field is a modulo 16 number used in the Acknowledgement header to indicate the sequence number to be attached to the next hub transmitted data packet. Send sequence numbers can be maintained in the launch pad database of both the hub and launch pad for each remote identification/logical unit number combination concurrently active.

Detailed Description Text (73):
A retransmit field can also be included in the launch pad data frame. It is desirable for the hub to maintain packet statistics in its launch pad database, such as the number of packets sent, received and retransmitted. One statistic the hub cannot measure directly is the number of packets lost while in-bound to the

hub. Thus, the launch pad can fill in this missing data by incrementing the retransmit field of the launch pad data header with each successive transmission attempt. This field is then reset upon reception of an acknowledgement from the hub.

Detailed Description Text (96):
Accordingly, exemplary embodiments of the present invention recognize that the launch pad can best determine its own bidding frequency and success rate, and that the launch pad can best adjust its bidding behavior to maintain an acceptable level of bid fairness within the communication network. For this reason, a fairness scheme in accordance with exemplary embodiments of the present invention enables each launch pad to monitor and regularly generate a bid index representing its performance based on the frequency and success rate of its bidding for access to the hub. Information used to generate this bid index is then forwarded to the hub in each bid attempt, where it is averaged with similar indices from all launch pads in the network. Consequently, the hub can generate and transmit a compiled hub goal index for the communication network back to each launch pad as a single indicator of the "health" of the total bid process among all bidding launch pads.

Detailed Description Text (97):
Using the goal index information, each launch pad can evaluate its bid performance relative to other launch pads in the communication network, and then adapt its bid behavior accordingly. For example, launch pads which have a high success rate in the bidding can, for example, be forced to bid less frequently (e.g., instead of bidding once every four TAF periods, be limited to bidding once every six TAF periods) while those doing poorly, can maintain or increase their bid frequency. For purposes of the following discussion, an increase in bid frequency will be referred to as a decrease in TAFs per group (TPG) while a decrease in bidding frequency will be referred to as an increase in TPG.

Detailed Description Text (116):
The hub, in accordance with exemplary embodiments, includes means, such as a processor, for establishing a second index representing an ability of one or more launch pads arbitrating for communication with the hub to actually communicate with the hub. The hub processor, in an exemplary embodiment, uses the same equation described above with respect to the bid index calculated by each launch pad, and therefore uses the same base data.

Detailed Description Text (163):
As the leveling off effect becomes more pronounced with increasing deterioration of the bid process, a point is reached where the transactions per second rate is virtually flat. The plateau index value of the worst TAF group bid index can be defined as that value occurring at the point where the transactions per second rate can be considered flat. FIG. 12 shows a table of "rule of thumb" plateau values for three integer disparity ratios (note that the values shown in FIG. 12 assume an exemplary 104 bytes per user data packet transferred). The plateau values of FIG. 12 are seen to be the breakaway values for each integer disparity ratio, lessened by a significant percentage. Simplification of a true transaction per second behavior curve can be achieved, at the cost of some accuracy, if the curve is approximated by two straight line segments, as indicated by the dotted lines in FIG. 12, To facilitate discussion, the discontinuity at the joining of the two line segments can fairly be assumed to occur at the breakaway index value. However, this is in reality an approximation only, and the discontinuity can actually span a small range of values.

Detailed Description Text (166):
A precise method for computing the worst TAF group bid index at the cross-over points between bid slot curves is difficult to determine. The switch point values depend not only on the length of the bid slots, but also on the network error rate, the host packet processing time, and the packet size of launch pad generated

transactions. Accordingly, reasonable "rule of thumb" approximations can be used to determine the bid slot switch points in accordance with exemplary embodiments of the present invention, and these switch points can be verified empirically if desired. Switch points that have been empirically proven to be good first-order approximations for the exemplary embodiments described above are summarized in the chart of FIG. 13. FIG. 13 shows an exemplary illustration wherein as the worst TAF group index reaches the plateau value of the two bid slot curve and then degrades to the switch point value A representing an exemplary value of 80 relative to the exemplary full scale value of 255, increasing the number of bid slots causes an index rebound B to an exemplary value of 115 on the four slot curve. Maintaining four slots until the second switch point C having an exemplary value of 56 causes a similar index rebound D to an exemplary value of 90 when transition is made to eight slots.

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